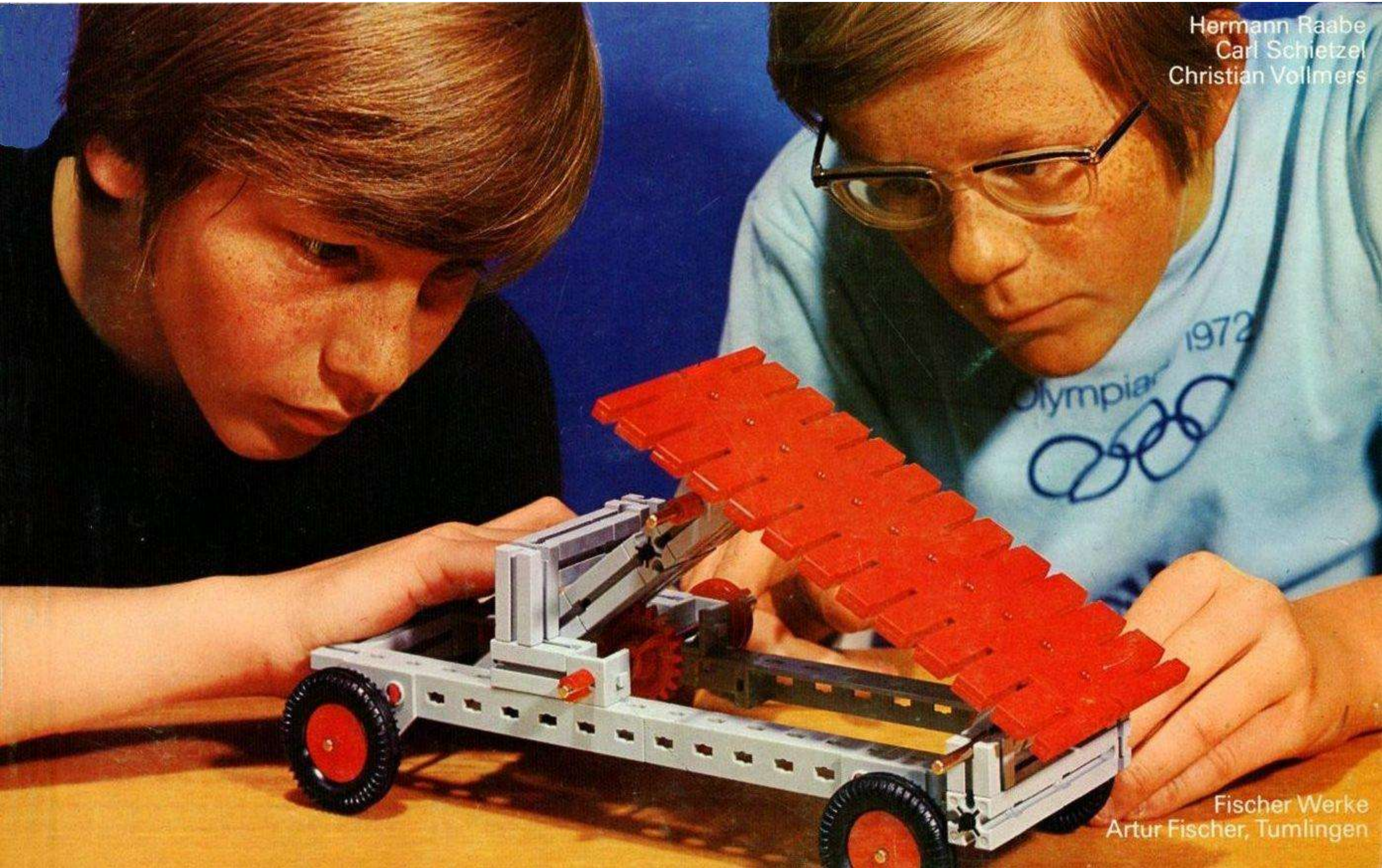
Learning Episodes For Discovering Technology In Elementary School



LEARNING EPISODES FOR DISCOVERING TECHNOLOGY IN ELEMENTARY SCHOOL

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The English version is 140 pages long and original copies are now available by emailing: procon@tpg.com.au

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Learning Episodes For Discovering Technology In Elementary School

– A Practical Program

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Forward

This book is conceived with the idea that there are alternatives to transmitting information, especially information of a technological nature, to students at the elementary grade level.

Specifically, a teaching technique in which the teacher does not impart information to the student; rather, the student is given the opportunity to discover such information on his own terms and pace through a media that is not restricted to one-dimensional cognitions. The vehicle for this guided discovery is a realistically designed manipulative which the student uses to solve the problems, sequentially arranged, posed by the teacher. The problems selected encourage the development of what may be called technical-functional thinking which we generally define as the ability to see and properly use the inherent connections of things and principles as they present themselves in our environment. The development of this thinking deepens our awareness of the way things work in our technological society, an understanding that may be considered immeasurably useful in our day to day living.

The content of this book is twenty-eight learning episodes oriented toward the above stated end. The text is supported by illustrations of how some of the students chose to solve the problems.

The pictures were taken by Herman Raabe and Christian Vollmers who also wrote the text. The information presented is concise and informative; our intention is to present an overview of this kind of program which is easily adaptable to any teacher's classroom.

The performance of our project was made possible by Mr. Artur Fischer, who let us use his material for our school experiments and who encouraged our work by word and deed. We thank him very much.

We hand over our teaching program to the educational public, fully confident that our work will stimulate teaching and learning in the elementary school.

Hamburg, Feb. 1972 *The Authors*

Technological Discoveries with Fischertechnik in Elementary School.

1. Child-Technological Discovery-School

This book contains learning episodes for discovering technology in elementary school. Each episode has been fundamentally explored in one of the classes, grades one through six, with boys and girls of all social levels. Discovering technology is intended to introduce the pupil to the technological world around him and to help him relate this to the modern life that we live. It also helps to train him early in life to think, and this work provides activities which define our world of work today, and more importantly for the future. The book is useful for information and the preparation of lessons for teachers who want to open up new directions to their students. The text and the illustrations provide the necessary tools. The goals of learning are stated and the methods of achieving them are given.
The major instructional material used in this program was a manipulative construction system called fischertechnik. With only one major material, full instruction cannot be totally achieved. However, within its range of application, the teaching possibilities of fischertechnik are unusually large and thorough. The illustrations prove this and explain more than two hundred pupil exercises which were produced in our lessons. The results were obtained through carefully prepared lessons in a normal classroom situation. Thus, every teacher can expect similar results from this method. The teacher does not need any technical experience; the only prerequisite is the willingness to familiarize herself with fischertechnik and other materials prior to their introduction in the classroom.
The building blocks proved themselves through the most variable conditions. They are easy for the child to assemble, and they do not provide problems during the lesson. From the beginning, the teacher must point out that the sense of working with fischertechnik is not to work with patterns as they stand in methodical instruction books for construction toys. Rather, the purpose is to stimulate the pupils to make and draw their own constructions and develop their technical skill and constructional thinking at the elementary level. This is achieved through the stimulation of creative inquiry. Technological discovery, in this sense, is an excellent way to develop intellectual creativity at a young age, although many skeptics would not give credit for such abilities in the technical area. This book will prove them otherwise.

2. Teaching Characteristics of Manipulative Materials

Participatory learning and manipulative materials develop a student's understanding of technical matters. The school takes part in this process of development, especially in the elementary school by providing material as "play" activity very slowly at first, then later by introducing additions to the material that have a stronger technical accent. The idea is to provide a sequentially designed material that will unfold the mysteries of technology by accompanying the student throughout his entire school career.
Our instruction experiments and philosophy were especially supported by fischertechnik. The building components are highlyprecisioned, versatile and easy to work with. They serve a maximum of teaching and technical functions. The assemblage is based upon building parts with connecting plugs and grooves that either snap fit or slide fit together providing innumerable connection possibilities. The set of construction parts, developed out of this basic assembly, forms a system which proved itself to be easy, quick and provided precise handling of the construction parts. Consequently, a few pieces offer a practically unlimited number of possibilities for realizing an effective understanding of the task at hand. The pictures and exercises illustrate this point.

The material challenges the student's imagination. It stimulates almost every child, whether boy or girl, to build and

construct, to discover, develop and understand technical models, such as airplanes (illus. 1.11 and 1.12). The material is also used to make houses, people, animals, etc. (illus. 1.19, 1.20, 21.5 and 28.5) - this helps the student to gain formative, intellectual power which contributes positive support to a comfortable self-image sought by the student. Energy, which was used until now in a mechanical sense, for the preparation of materials (such as the lengthening of ledges, the sawing of wood, the drilling of holes and the smoothing of surfaces, etc.), can also be used for constructing, controlling, correcting and further developing the important intellectual activities within the work process. One cannot deny that the time-wasting and troublesome mechanical activities also have educational value. There is no probable way to develop the recognition of the qualities of axles and tires more emphatically than from experience, that is, if pupils set to work with a saw, a rasp, a borer and emery paper to make the four tires a car out of a piece of wood. But isn't such an execution a contradiction to the binding law of proportion of means? If you can compare the advantages and disadvantages, the prepared materials must be favored. They are better because of the freedom which is allowed to the teacher as well as the student. The materials are ready to use and are easy to use. With this ability, fischertechnik ranks high among all those other products which free one from complex and difficult work. This method does not support the laziness of men, but it does encourage his desire for a greater possible significant achievement.

If you can compare student creations from fischertechnik with creations made out of boxes, cans, cartons and textiles, then it seems clear in certain cases, to grant these last named products a bigger individuality of expression. But it has to be considered that in both of these cases it is a question of childlike creativity, and that the evaluation is a bit falsified by the many colored impressions of certain tinkering works and through the existing remains of an ardent but still clumsy child-hand. It is often unnoticed that the performance of a child at elementary school which adults often value as beautiful, is in most cases intended in another way. The pupil at the elementary level, even pupils of the first grade, want to achieve an operable understanding of technological principles. The important thing for the child is that his model works, not that it is a beautiful one, especially if the child has built something like a bridge or a cranecar. The child wants accuracy, success and functional movement. The desire to produce the work with one's own hand, according to the technical fundamental principle of "I can do it myself", is one of the oldest behaviors of men, upon which its existence depends, and this attitude appears in the youngest child.

The tendency of the creative child is a manifestation of his inherent drives of curiosity and manipulation. They provide for the creative achievement of the pupil, encouraging his perceptual and conceptual development in a qualitative direction. The observation of pupils at elementary school in the first through six grades shows that the child builds with his imagination. Seen from the adult's point of view, imagination is sometimes considered a useless side product. For the child, however, in most cases, it is a necessary and important intellectual process that enables the child to make a clarification or expression with the help of his constructional ideas and ground plans. It is an expression of the same intellectual structure, if the relevant use and realization of the idea happens in the mode of playing. A good way of affirming success at the elementary level is for the student to play with the realization of his idea, his model.

Finally, it must be considered that the child who is constructing, largely identifies himself with the technical instrument. This childlike "anthropomorphism" appears in all these cases where the child undertakes the function itself instead of providing for a technical function through a construction. That is, where they overload a dump truck (illus. 13.1), where they work with signals (illus. 12.9), where they move a hammer mill (illus. 10.10), where they steer a vehicle (illus. 18.3), etc. These observations should warn us to keep the pupil at the elementary level open for abstract technical thinking. The identification with the model happens until the fourth scholastic year. It does not admit an exclusive rational un-

derstanding of technical facts of the case. Lessons which would be based on these principles would make impossible the so called rationalization of thinking, that is to say the education of logical judgment and conclusion.

The use of technical manipulative material not only encourages technological understanding and knowledge but also improves technological thinking as well. Can fischertechnik support this statement? The teaching effectiveness of fischertechnik has two arguments. First, hands and eyes get used to the original function of technical work, by using the precisely structured materials. Hands and eyes become trained for the understanding of this technique. This is exemplified by the type of work that is learned such as building parallel axles, balancing trestles, making power transmitting machinery, etc. Construction-functional associations are gained by technical-functional thinking and can later be applied to problems encountered afterwards.

Another reason is that the produced objects (conveyor belts, dump trucks, scales, animal traps, reapers, etc.) really work. The consequence is that the given technological principles are real, exact and brought to a clear understanding in this way. Skills, such as steering, securing, stabilizing and making power transmissions are recognized by the student. Through the intuitive product made by the pupils, in which their idea of construction becomes reality, they develop functional thinking which explains objective structural cohesions and functions. This applies not only to technical structures, but to other problems in general.

In this case, we have a single relation between the concrete and intuitive thinking and working with the idea of understanding technology. That is the last reason why discovering technical ideas is already so successful in elementary school and why it produces the evolution and development of thinking.

3. Style and Organization of Lessons

The experience showed that up to forty pupils can take part in the lessons successfully. In such an exceptional case, the teacher is able to advise only a small part of the pupils and give suggestions for further work. In classes or courses with only twenty pupils, the lessons proceed with very few problems and are very pleasant. Because the building material supports the organization of teaching by the way of utilization, the teacher has more time to talk to individual pupils or groups of pupils, and correct exercises if it seems necessary.

Beginning and ending of lessons (to distribute and put away materials) requires only a small part of the teaching time. The work is confined to one space at a time because the student has to have the material in front of him and because the tools do not have to be controlled. There is no mess and bothersome garbage. The pupils must be allowed to borrow building elements from other pupils. Mutual help must be selfevident.

If in a school only one class works with fischertechnik at a time, one or two students should always be responsible for the accountability of parts to minimize their loss. Distribution of materials before the lesson saves time and cuts down on disturbances. The building blocks are practically stored and carried in plastic baskets and boxes and only if necessary, in cardboard boxes.

Before the teacher uses a pre-planned lesson, the students should be allowed to play freely with the materials. Even at the beginning of the second school year, a double period should be given for them to reacquaint themselves with the building parts.

The beginner has to be given instruction for the connection of the building elements and for the stability and quality of the material. The use of these parts can be easily understood from the methodical instructions. If the pupils use the instructions which are labeled on the box by themselves, their intuitiveness must be encouraged. It takes about twenty minutes for the beginning student to replace the blocks at the end of the period; later on the time is cut down to about ten minutes. Each time the blocks are replaced, the teacher should check to make sure everything is put back. Another goal of this type of education is to teach responsibility and conscientiousness, two qualities which are not always evident in our present consumer society.

Christiane B., Grade 2

10. Poor Pupils

One photograph documents the case of Frank K. (illus. 1.2). It shows how the poor pupil, especially if he cannot concentrate or collect his thoughts, can be stimulated to achievements which are high above his understanding. Frank K. was only able to write five consecutive letters before he gave up. With the help of fischertechnik, he concentrated for thirty minutes and worked with them. The product upon which he concentrated shows that the mental power has not developed enough for him to make a clear plan. The child used a special imagination which is expressed in his construction. There is one thing the illustration cannot show: that the pupil gained an interest in work which was not brought out in any of his other classes. Also contributing to his new found interest was the self-confidence which was restored when the boy produced work which at last was correct. The construction was correct because it produced a good effect on Frank, and it made him learn to work independently and gave him the initiative to continue building with the material. Fischertechnik has, as this example shows, a high learning value for poor and hard to teach, although able, pupils.

11. Boys and Girls

The girls showed the same interest as the boys. Their non-scholastic interest concerning technological considerations, however, is smaller on the average. It should give us something to think about that in one of the classes, eight of the girls wanted to get fischertechnik for Christmas, but none of them received a set. At the beginning of the teaching, the girls mostly were inferior to the boys with regard to their technical knowledge and their appropriate thinking ability. In the course of the lesson, they learned more than the boys. In this way, the difference between the achievements was considerably reduced at the end of these phase. Not only a few of the best performances were made by girls (iIlus. 10.3, 18.13, 22.5). With regard to the speed of constructing, no differences between boys and girls could be noticed.

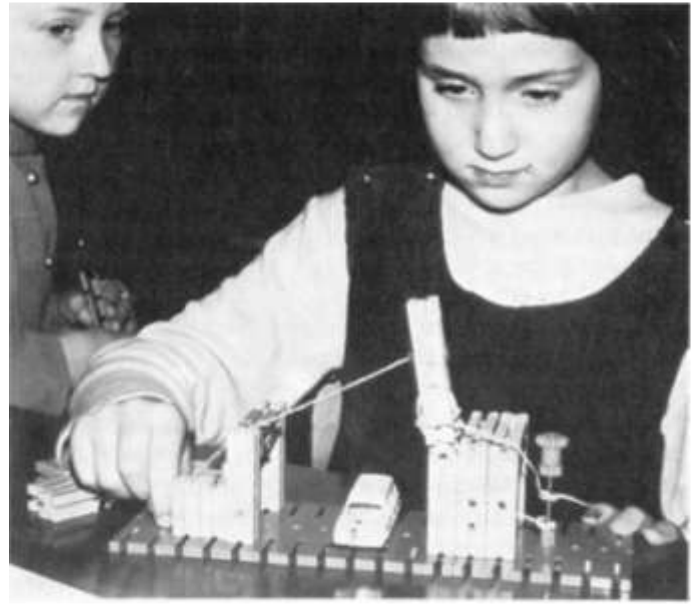
12. Cooperation

There was a very favorable turnout of cooperation among the pupils, a thing which cannot be contradicted as a high educational goal. In this case, the students worked spontaneously in freely chosen groups harmoniously with no exceptions. It must be mentioned that the students worked mostly in pairs consisting of girls or boys. Even if a larger group worked together, the degree of cooperation remained the same.

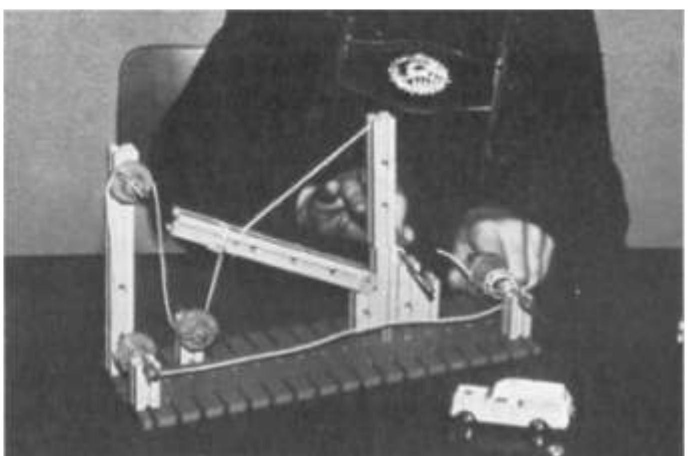
It was beneficial to have enough material to promote this cooperation among the students. Therefore, there were no fights over the material. The distribution of the tasks to the groups of partners took place without any prolonged discussion which is remarkable because the tasks were not always as simple as those of making cars and caravans or ferris wheels and gondolas. It was much more complicated in cases such as crane-frames, crane jibs, pile bridges, etc., where the task required the students to use their equipment wisely and make due with what they were given even if it meant making adjustments.

The cooperation manifested itself in many ways. If we take a standard case of two pupils building (iIlus. 15.1), another pair of students may sit by and watch, comment or suggest. Another procedure may be forthe less able pupil to assist the better one. In both cases, the observing part of the task is not considered to be a passive one although sometimes it cannot be completely excluded. However, passivity usually does not become a problem with this method. Thomas and Vincent, pupils in the class, show a friendly cooperation (illus. 16.5) and George Oe. and Thomas P. do the same. They are a good example of good interpersonal relationships and they show that they are having fun while creating the products they made together. (Color picture, page 72.)

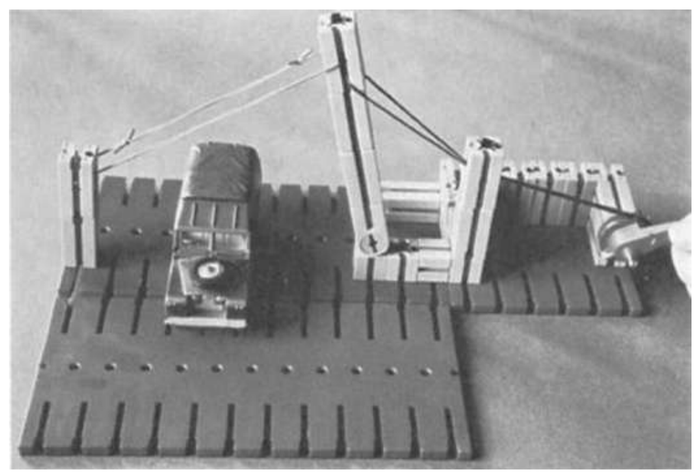
4.2 Steven H., Grade 2



4.3 Helen S., Grade 3



4.4 Martin T., Grade 2



4.5 Anglea H., Grade 3